

Claims

- [c1] 1. A fuel cell assembly comprising:
at least one fuel cell comprising
a. an anode and a cathode held in a spaced apart relationship by at least one spacer element, said at least one spacer element comprising an electrically insulating material, a proximal end in contact with said cathode, and a distal end in contact with said anode;
b. an electrolyte comprising a molten salt having a hydride ion conductance number greater than about 0.95 at a fuel cell operating temperature, said electrolyte disposed between, and in contact with, said anode and said cathode;
c. a fuel gas inlet for delivering a fuel gas to said electrolyte, wherein said fuel gas inlet is adjacent to said cathode;
d. a oxidizing gas inlet for delivering a oxidizing gas to said electrolyte, wherein said oxidizing gas inlet is adjacent to said anode; and
e. an exhaust port in fluid communication with said anode.
- [c2] 2. The fuel cell assembly of claim 1, wherein at least one of said anode and said cathode comprises a hydrogen permeable solid membrane.
- [c3] 3. The fuel cell assembly of claim 2, wherein said membrane comprises at least one material selected from the group consisting of palladium, vanadium, beta titanium, and an alloy comprising palladium and silver.
- [c4] 4. The fuel cell assembly of claim 1, wherein at least one of said anode and said cathode comprises at least one sintered refractory material.
- [c5] 5. The fuel cell assembly of claim 4, wherein said sintered refractory material comprises at least one material selected from the group consisting of molybdenum, tungsten, rhenium, and vanadium.
- [c6] 6. The fuel cell assembly of claim 4, wherein at least one of said anode and said cathode further comprises a composite material, said composite material comprising said sintered refractory material and a hydrogen-permeable solid membrane.
- [c7] 7. The fuel cell assembly of claim 1, wherein at least one of said anode and said

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- [c8] 8.The fuel cell assembly of claim 1, wherein at least one of said anode and said cathode is tubular.
- [c9] 9.The fuel cell assembly of claim 1, wherein at least one of said anode and said cathode has a thickness in the range from about 50 microns to about 500 microns.
- [c10] 10.The fuel cell assembly of claim 9, wherein said thickness is in the range from about 50 microns to about 250 microns.
- [c11] 11.The fuel cell assembly of claim 10, wherein said thickness is in the range from about 75 microns to about 150 microns.
- [c12] 12.The fuel cell assembly of claim 1, wherein said molten salt comprises at least one molten alkali halide and at least one molten metal hydride.
- [c13] 13.The fuel cell assembly of claim 12, wherein said alkali halide of said molten salt is selected from the group consisting of lithium chloride, lithium bromide, lithium fluoride, potassium chloride, potassium bromide, potassium fluoride, sodium chloride, sodium bromide, sodium fluoride, and mixtures thereof.
- [c14] 14.The fuel cell assembly of claim 12, wherein said alkali hydride of said molten salt is selected from the group consisting of lithium hydride, potassium hydride, sodium hydride, and mixtures thereof.
- [c15] 15.The fuel cell assembly of claim 14, wherein said molten salt comprises said alkali hydride in the range of about 5 weight percent to about 25 weight percent.
- [c16] 16.The fuel cell assembly of claim 15, wherein said molten salt comprises said alkali hydride in the range of about 5 weight percent to about 20 weight percent.
- [c17] 17.The fuel cell assembly of claim 16, wherein said molten salt comprises said alkali hydride in the range of about 10 weight percent to about 20 weight percent.

- [c18] 18.A fuel cell assembly as in claim 1, wherein said fuel cell temperature is in the range from about 250⁰ C to about 650⁰ C.
- [c19] 19.A fuel cell assembly as in claim 1, wherein said fuel cell temperature is in the range from about 250⁰ C to about 600⁰ C.
- [c20] 20.A fuel cell assembly as in claim 1, wherein said fuel cell temperature is in the range from about 300⁰ C to about 450⁰ C.
- [c21] 21.The fuel cell assembly of claim 1, wherein said at least one spacer element comprises at least one material selected from the group consisting of alumina, zirconia, boron nitride, silicon nitride, aluminum nitride, and silicate glass.
- [c22] 22.A fuel cell assembly comprising:
at least one fuel cell comprising
a. an anode and a cathode held in a spaced apart relationship by at least one spacer element, said at least one spacer element comprising an electrically insulating material, a proximal end in contact with said cathode, and a distal end in contact with said anode;
b. an electrolyte comprising at least one molten alkali metal halide selected from the group consisting of lithium chloride and potassium chloride and further comprising lithium hydride, said electrolyte disposed between, and in contact with, said anode and said cathode;
c. a fuel gas inlet for delivering a fuel gas comprising hydrogen to said electrolyte, wherein said fuel gas inlet is adjacent to said cathode;
d. a oxidizing gas inlet for delivering a oxidizing gas comprising oxygen to said electrolyte, wherein said oxidizing gas inlet is adjacent to said anode; and
e. an exhaust port in fluid communication with said anode
- [c23] 23.The fuel cell assembly of claim 22, wherein the fuel gas comprises hydrogen.
- [c24] 24.The fuel cell assembly of claim 23, wherein said fuel gas is a gas comprising at least one of methane and propane.
- [c25] 25.The fuel cell assembly of claim 22, wherein the oxidizing gas comprises oxygen.

- [c26] 26.The fuel cell assembly of claim 25, wherein oxidizing gas comprises air.
- [c27] 27.The fuel cell assembly of claim 22, wherein said fuel cell assembly comprises a plurality of said fuel cells connected electrically.
- [c28] 28.A fuel cell comprising:
an anode;
a cathode in a spaced-apart relationship with said anode;
a source of hydride ions in fluid communication with said cathode;
a source of oxygen in fluid communication with said anode; and an electrolyte comprising a molten salt, said molten salt having a hydride ion conductance number greater than about 0.95 at a fuel cell operating temperature.
- [c29] 29.The fuel cell of claim 28, wherein said molten salt comprises at least one molten alkali halide and at least one molten metal alkali hydride.
- [c30] 30.The fuel cell of claim 29, wherein said molten alkali halide of said molten salt is selected from the group consisting of lithium chloride, lithium bromide, lithium fluoride, potassium chloride, potassium bromide, potassium fluoride, sodium chloride, sodium bromide, sodium fluoride, and mixtures thereof.
- [c31] 31.The fuel cell of claim 29, wherein said molten metal alkali hydride of said molten salt is selected from the group consisting of lithium hydride, potassium hydride, sodium hydride, and mixtures thereof.
- [c32] 32.The fuel cell assembly of claim 29, wherein said molten salt comprises said molten metal alkali hydride in the range of about 5 weight percent to about 25 weight percent.
- [c33] 33.The fuel cell assembly of claim 32, wherein said molten salt comprises said alkali hydride in the range of about 5 weight percent to about 20 weight percent
- [c34] 34.The fuel cell assembly of claim 33, wherein said molten salt comprises said alkali hydride in the range of about 10 weight percent to about 20 weight percent.
- [c35] 35.The fuel cell of claim 28, wherein said fuel cell temperature is in the range

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from about 300⁰ C to about 450⁰ C.